Archaeomicrobiology: Method Development to "Fingerprint" Australian Cultural Ochre Using Microbial DNA Analysis

Rachel S. Popelka-Filcoff
School of Geography, Earth and Atmospheric Sciences, University of Melbourne, Melbourne, Australia 3010

Claire E. Lenehan
College of Science and Engineering, Flinders University, Adelaide, Australia 5001

Shanan S. Tobe
College of Science, Health, Engineering and Education, Murdoch University, Murdoch, Australia 6150

A fundamental question in archaeological science studies is the concept of "provenance", where the origins of a material or artefact can be characterized and determined. Over past decades, several approaches have been successfully implemented including physical and chemical analytical methods. However, microbial DNA within the source materials holds a promising novel method for determination of the characteristic "fingerprint" of a source, in particular for complex archaeological materials such as ochre. Natural mineral pigments are a complex cultural heritage material frequently observed in archaeological sites worldwide and is often of unknown provenance. [1, 2] Recent studies using DNA profiling of bacteria have been used for the forensic determination of soils, towards determination of geographic origin. [3] This paper presents a novel approach to the provenance of archaeological minerals and related materials through the use of 16S rRNA sequencing analysis of microbial DNA. Data from 16S rRNA sequencing studies provide profiles of ochre sources that are both independent of and complementary to elemental and mineralogical analyses. Through the microbial DNA characterization from ochre and subsequent multivariate statistical analysis (Non-metric multi-dimensional scaling (NMDS) of Bray-Curtis similarities and canonical analysis of principal coordinates (CAP) on the sum of squared canonical correlations) we have demonstrated the clear discrimination between four geographically and mineralogically distinct Australian cultural ochre sites.[4] This work demonstrates that trace microbial content in archaeological samples provide a yet unexploited source of information for provenance studies and outlines the possibilities towards the application to other culturally important geological materials.

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